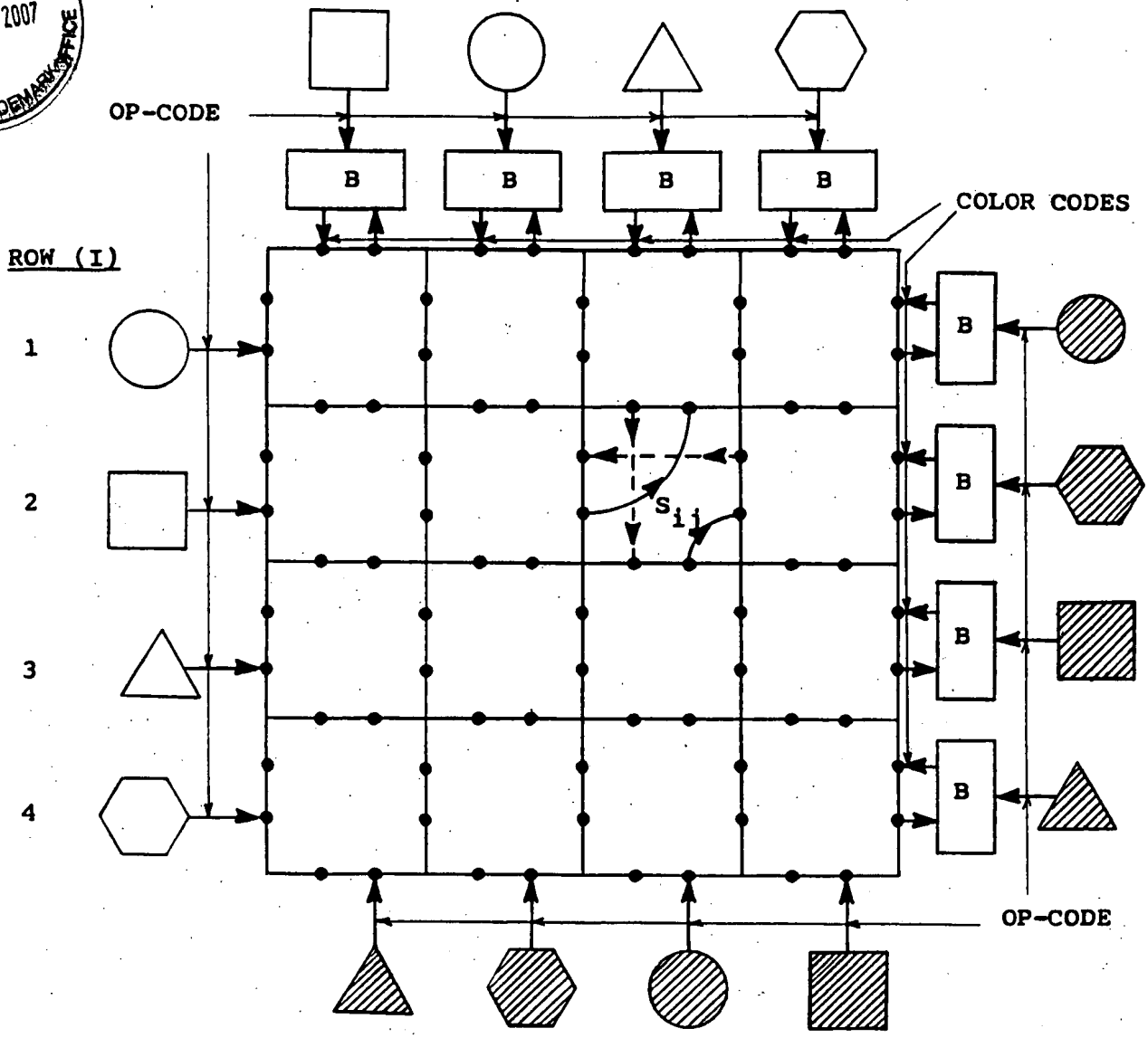


B: BOOLEAN FUNCTION

OBJECT	○	⬡	□	△	●	⬢	■	▲
OP-CODE	000	001	010	011	100	101	110	111

GEOMETRIC LAYOUT OF DEVICE FOR N = 4

FIG. 1

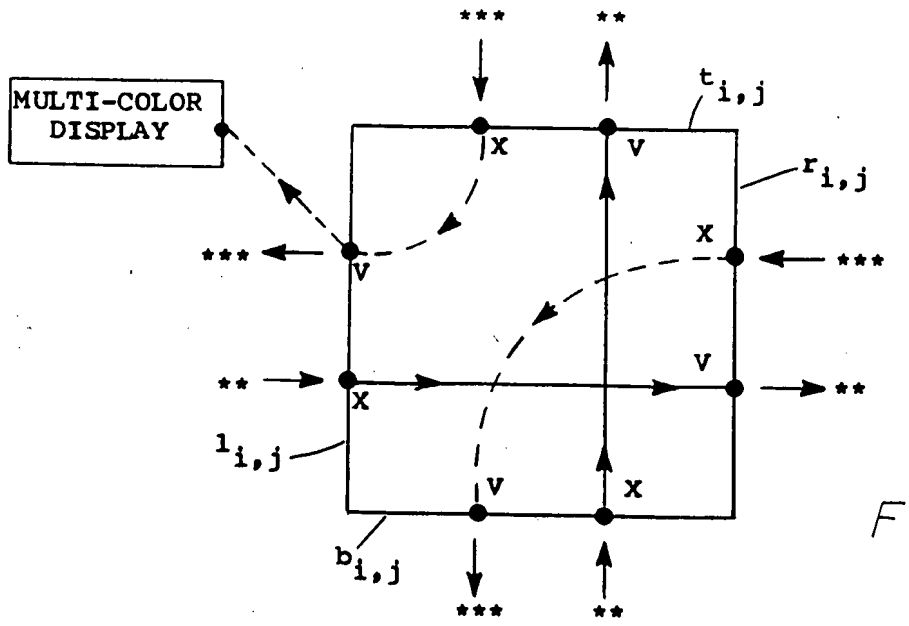


FIG. 2a

SWITCH $W_{i,j}$: ON ("1")

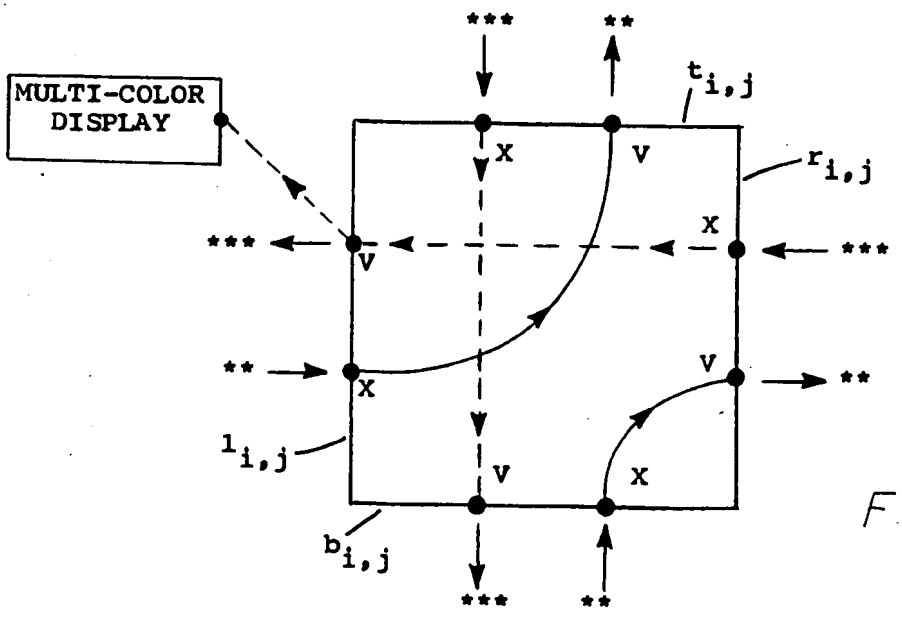
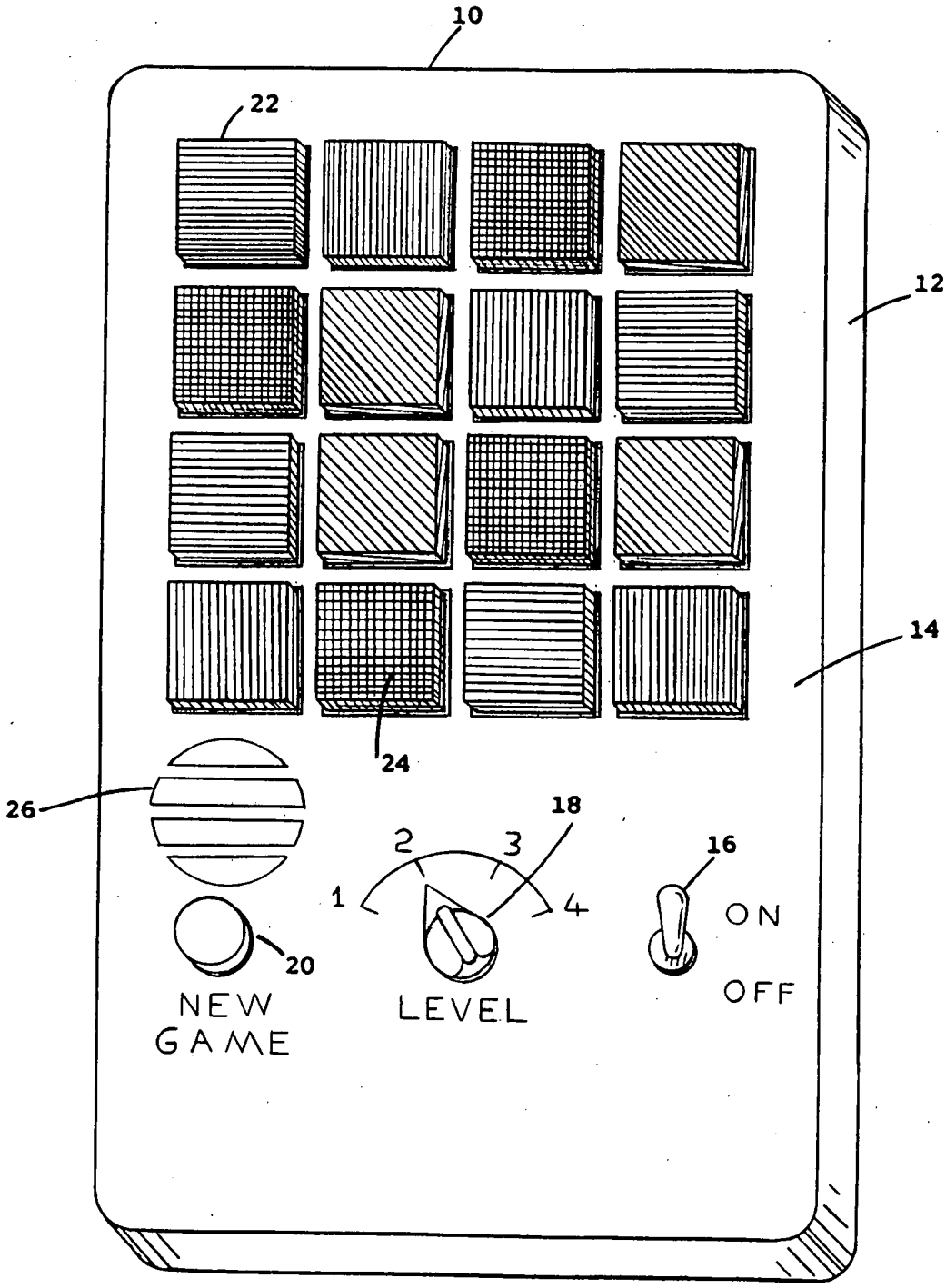


FIG. 2b

SWITCH $W_{i,j}$: OFF ("0")

LEGEND: ** OP-CODE
*** COLOR CODE

ROUTING SQUARE $S_{i,j}$



HAND HELD LOGIC GAME DEVICE

FIG. 3

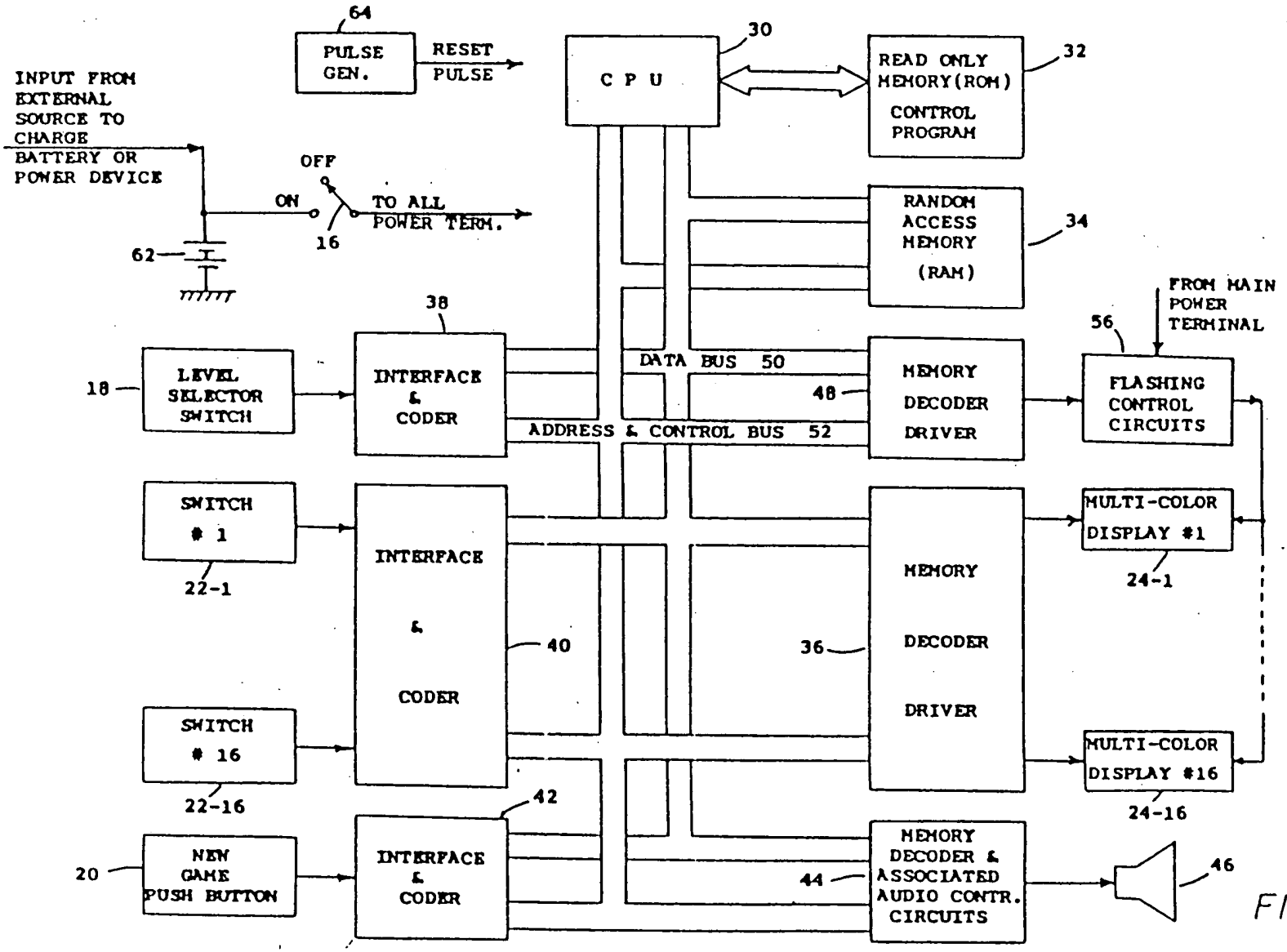

64
PULSE GEN.
RESET PULSE
C P U
30
READ ONLY MEMORY (ROM)
CONTROL PROGRAM
32
INPUT FROM EXTERNAL SOURCE TO CHARGE BATTERY OR POWER DEVICE
OFF
ON
TO ALL POWER TERM.
16
62
RANDOM ACCESS MEMORY (RAM)
34
FROM MAIN POWER TERMINAL
56
38
18
LEVEL SELECTOR SWITCH
INTERFACE & CODER
DATA BUS 50
48
MEMORY DECODER DRIVER
FLASHING CONTROL CIRCUITS
ADDRESS & CONTROL BUS 52
SWITCH # 1
22-1
INTERFACE & CODER
40
36
MEMORY DECODER DRIVER
MULTI-COLOR DISPLAY #1
24-1
SWITCH # 16
22-16
MULTI-COLOR DISPLAY #16
24-16
42
20
NEW GAME PUSH BUTTON
INTERFACE & CODER
44
MEMORY DECODER & ASSOCIATED AUDIO CONTR. CIRCUITS
46

FIG. 4

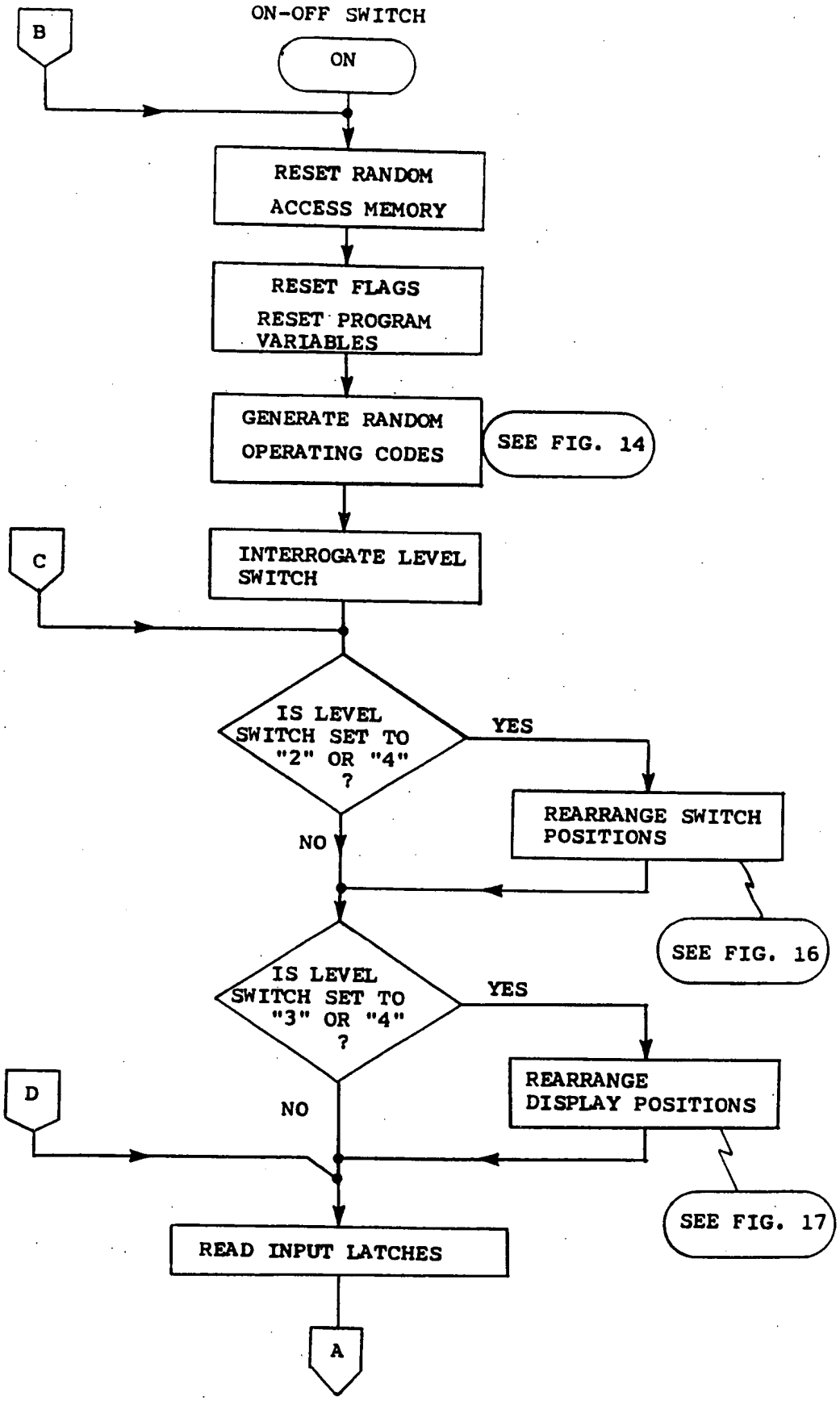

B
ON-OFF SWITCH
ON
RESET RANDOM ACCESS MEMORY
RESET FLAGS
RESET PROGRAM VARIABLES
GENERATE RANDOM OPERATING CODES
SEE FIG. 14
C
INTERROGATE LEVEL SWITCH
IS LEVEL SWITCH SET TO "2" OR "4" ?
YES
NO
REARRANGE SWITCH POSITIONS
SEE FIG. 16
IS LEVEL SWITCH SET TO "3" OR "4" ?
YES
NO
D
REARRANGE DISPLAY POSITIONS
SEE FIG. 17
READ INPUT LATCHES
A

FIG. 5

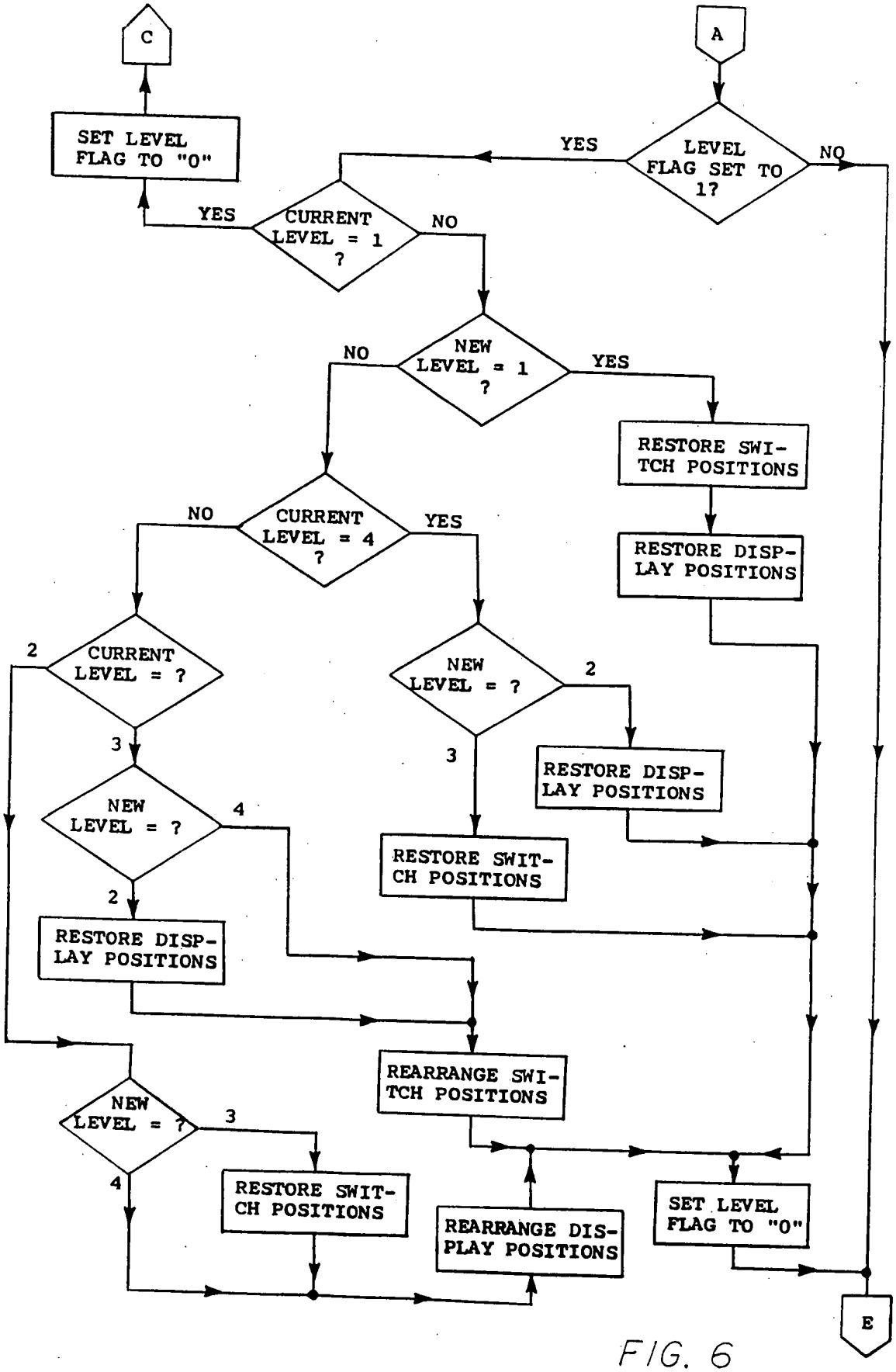

C
A
SET LEVEL FLAG TO "0"
LEVEL FLAG SET TO 1?
YES
NO
CURRENT LEVEL = 1 ?
YES
NO
NEW LEVEL = 1 ?
NO
YES
RESTORE SWITCH POSITIONS
RESTORE DISPLAY POSITIONS
CURRENT LEVEL = 4 ?
NO
YES
CURRENT LEVEL = ?
2
3
NEW LEVEL = ?
4
RESTORE DISPLAY POSITIONS
RESTORE SWITCH POSITIONS
NEW LEVEL = ?
2
3
RESTORE DISPLAY POSITIONS
REARRANGE SWITCH POSITIONS
NEW LEVEL = ?
3
4
RESTORE SWITCH POSITIONS
REARRANGE DISPLAY POSITIONS
SET LEVEL FLAG TO "0"
E

FIG. 6

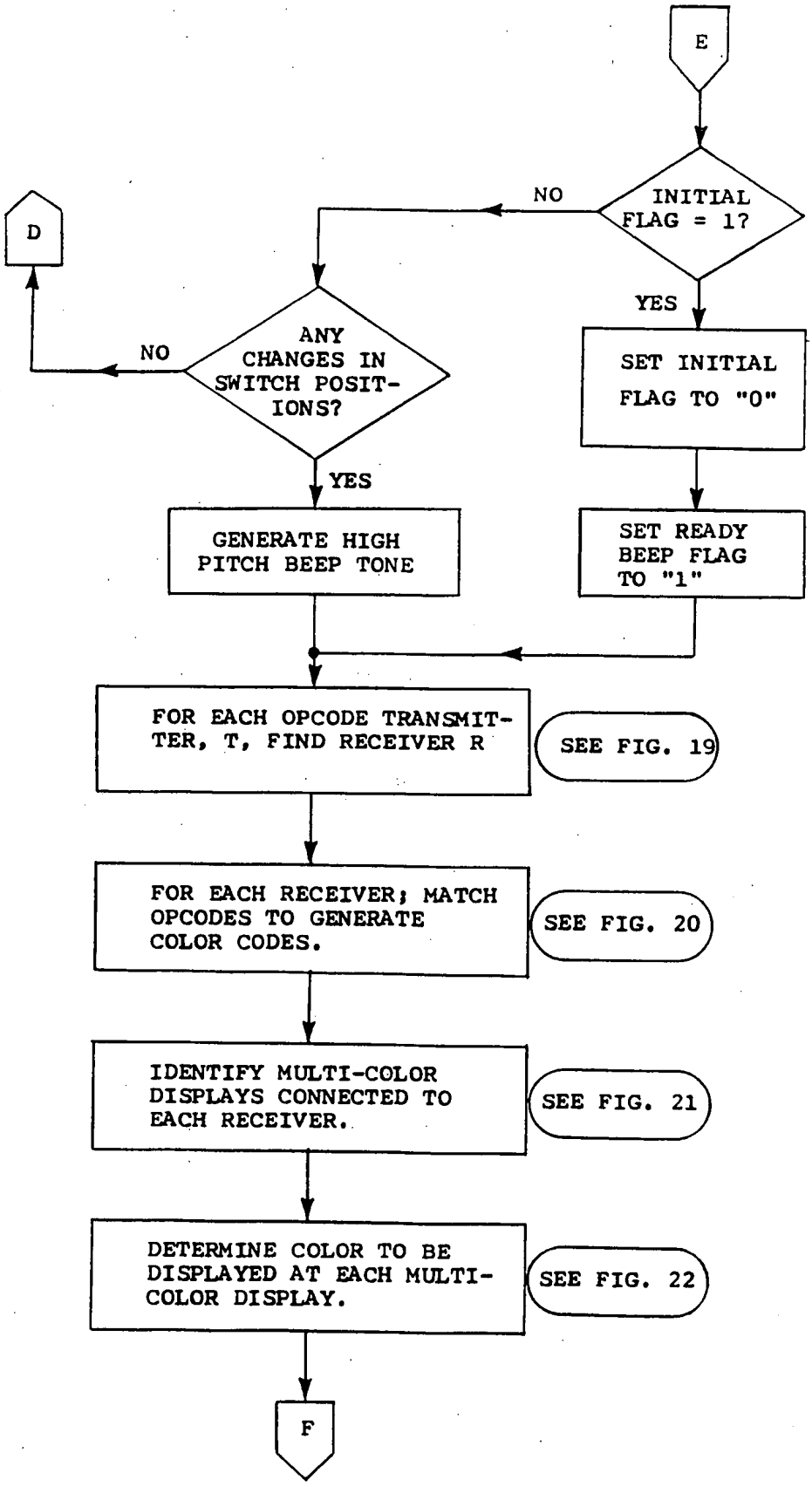

E
INITIAL FLAG = 1?
NO
YES
D
ANY CHANGES IN SWITCH POSIT-IONS?
NO
YES
SET INITIAL FLAG TO "0"
GENERATE HIGH PITCH BEEP TONE
SET READY BEEP FLAG TO "1"
FOR EACH OPCODE TRANSMIT-TER, T, FIND RECEIVER R
SEE FIG. 19
FOR EACH RECEIVER; MATCH OPCODES TO GENERATE COLOR CODES.
SEE FIG. 20
IDENTIFY MULTI-COLOR DISPLAYS CONNECTED TO EACH RECEIVER.
SEE FIG. 21
DETERMINE COLOR TO BE DISPLAYED AT EACH MULTI-COLOR DISPLAY.
SEE FIG. 22
F

FIG. 7

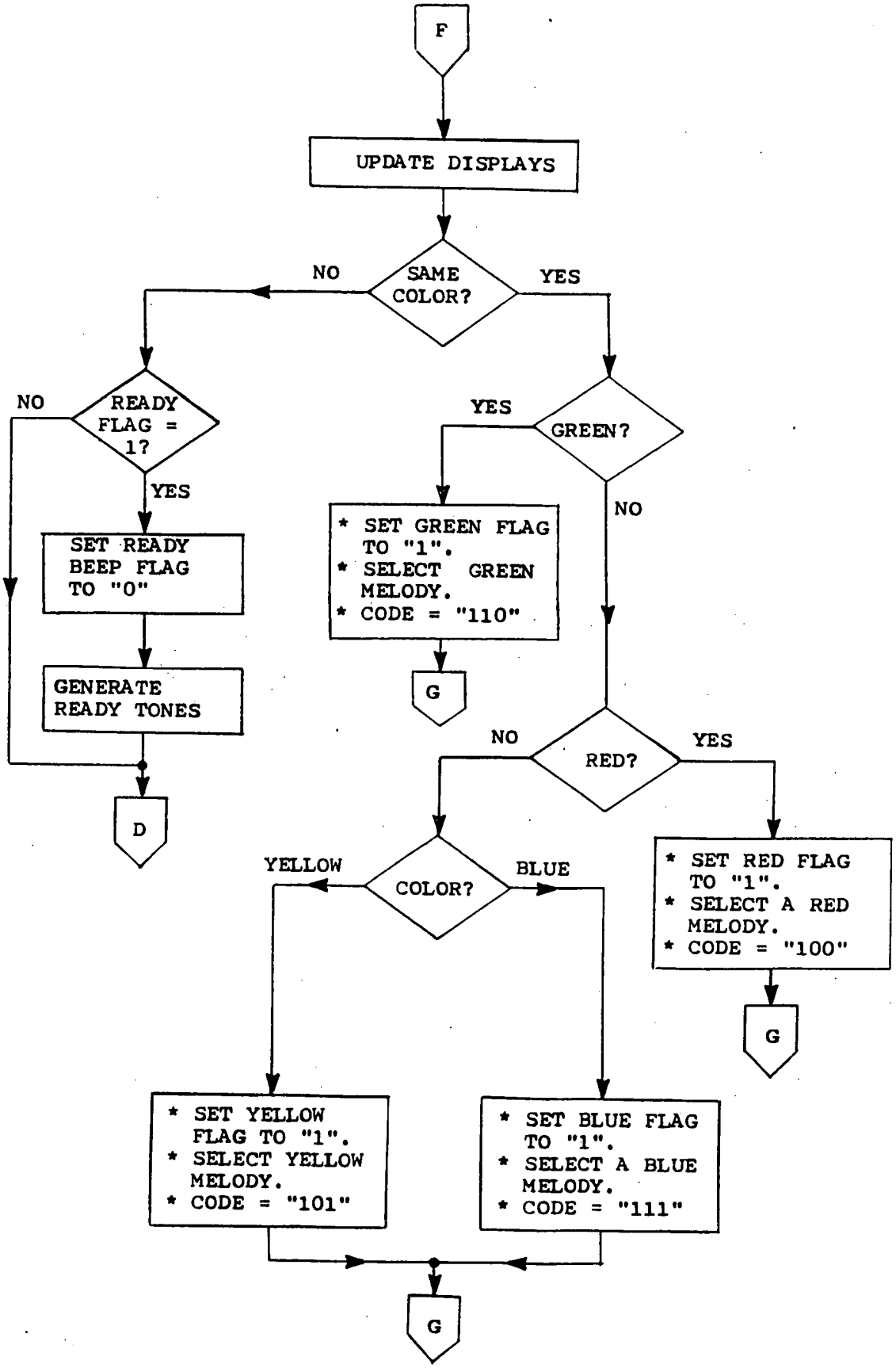

F
UPDATE DISPLAYS
SAME COLOR?
NO
YES
READY FLAG = 1?
NO
YES
SET READY BEEP FLAG TO "0"
GENERATE READY TONES
D
GREEN?
YES
NO
* SET GREEN FLAG TO "1".
* SELECT GREEN MELODY.
* CODE = "110"
G
RED?
NO
YES
* SET RED FLAG TO "1".
* SELECT A RED MELODY.
* CODE = "100"
G
COLOR?
YELLOW
BLUE
* SET YELLOW FLAG TO "1".
* SELECT YELLOW MELODY.
* CODE = "101"
* SET BLUE FLAG TO "1".
* SELECT A BLUE MELODY.
* CODE = "111"
G

FIG. 8

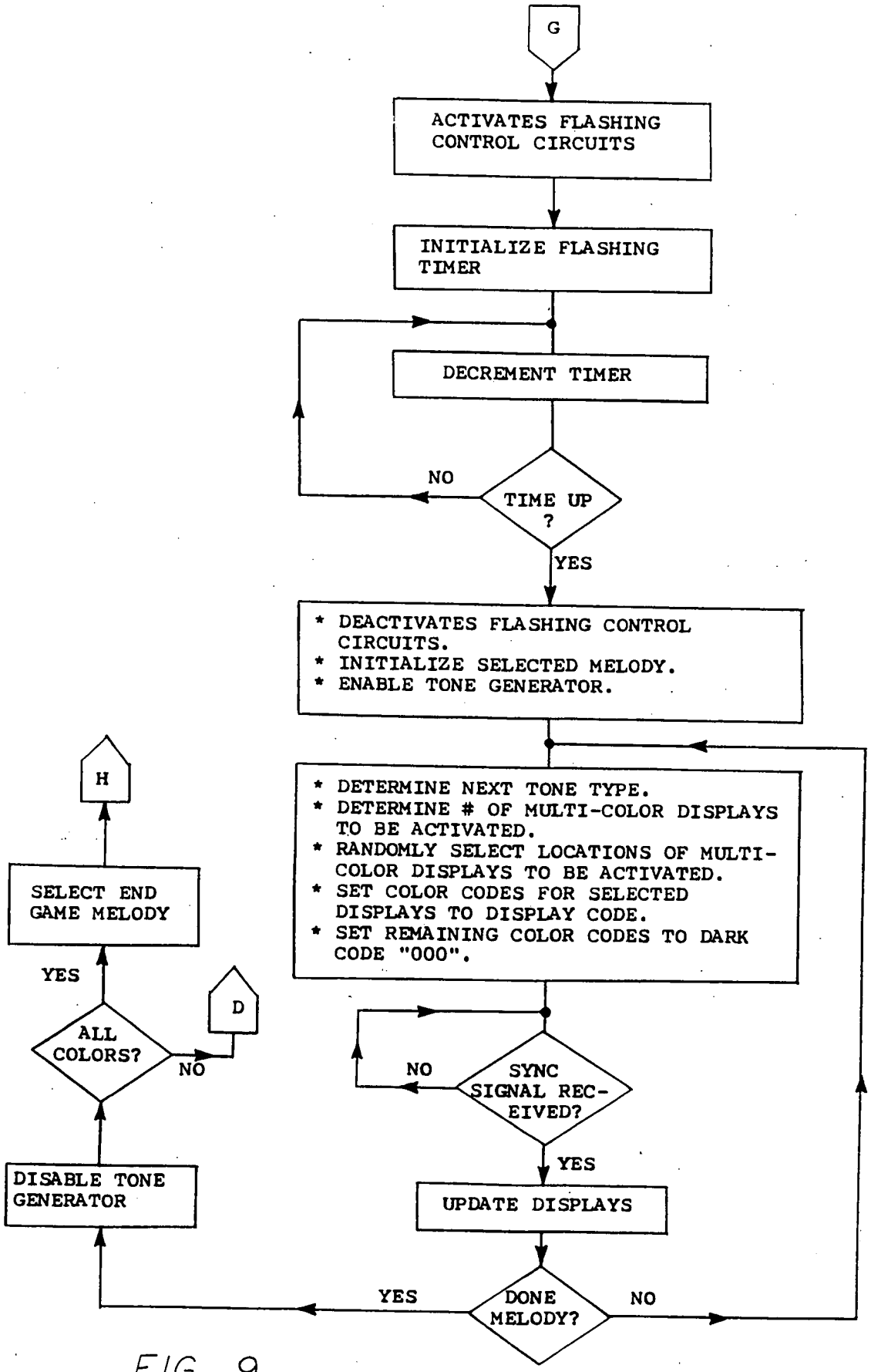

G
ACTIVATES FLASHING CONTROL CIRCUITS
INITIALIZE FLASHING TIMER
DECREMENT TIMER
NO
TIME UP ?
YES
* DEACTIVATES FLASHING CONTROL CIRCUITS.
* INITIALIZE SELECTED MELODY.
* ENABLE TONE GENERATOR.
* DETERMINE NEXT TONE TYPE.
* DETERMINE # OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
* RANDOMLY SELECT LOCATIONS OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
* SET COLOR CODES FOR SELECTED DISPLAYS TO DISPLAY CODE.
* SET REMAINING COLOR CODES TO DARK CODE "000".
NO
SYNC SIGNAL REC-EIVED?
YES
UPDATE DISPLAYS
YES
DONE MELODY?
NO
ALL COLORS?
NO
D
YES
SELECT END GAME MELODY
H
DISABLE TONE GENERATOR

FIG. 9

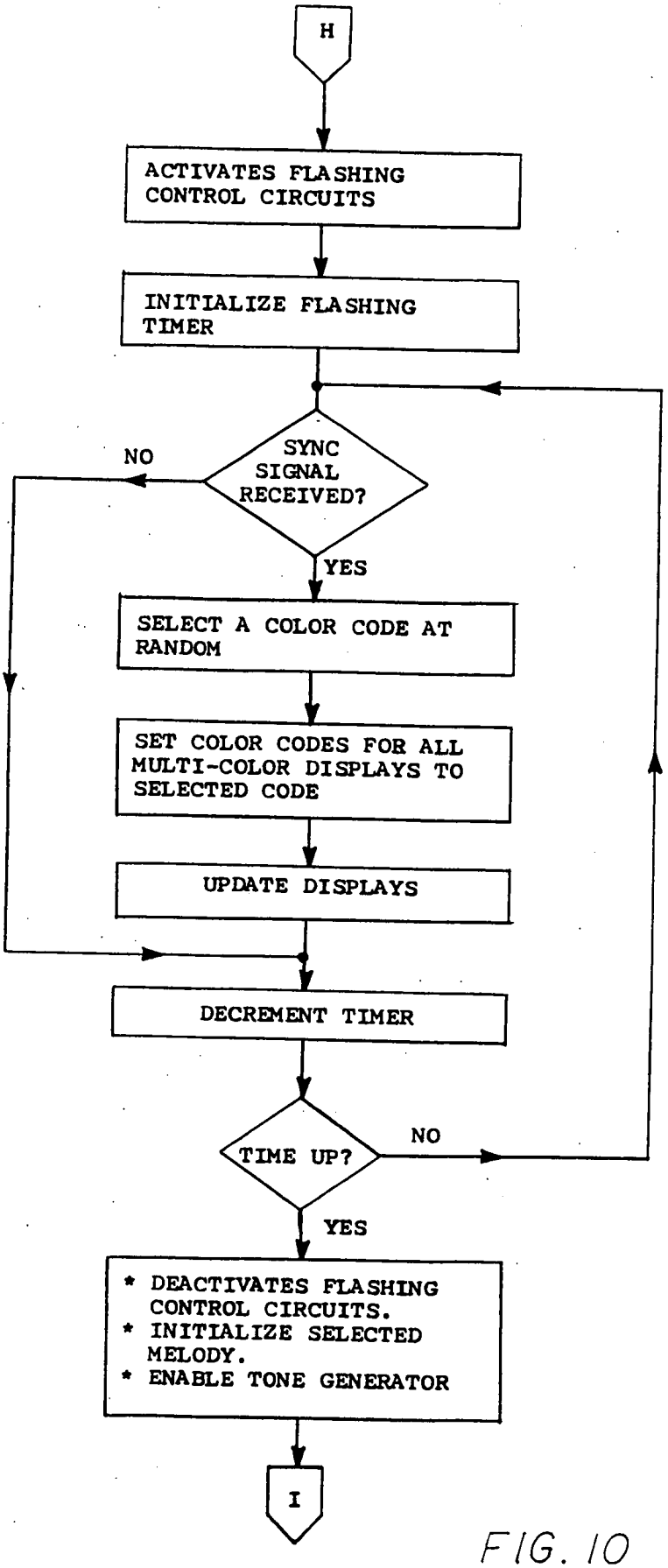

H
ACTIVATES FLASHING CONTROL CIRCUITS
INITIALIZE FLASHING TIMER
SYNC SIGNAL RECEIVED?
NO
YES
SELECT A COLOR CODE AT RANDOM
SET COLOR CODES FOR ALL MULTI-COLOR DISPLAYS TO SELECTED CODE
UPDATE DISPLAYS
DECREMENT TIMER
TIME UP?
NO
YES
* DEACTIVATES FLASHING CONTROL CIRCUITS.
* INITIALIZE SELECTED MELODY.
* ENABLE TONE GENERATOR
I

FIG. 10

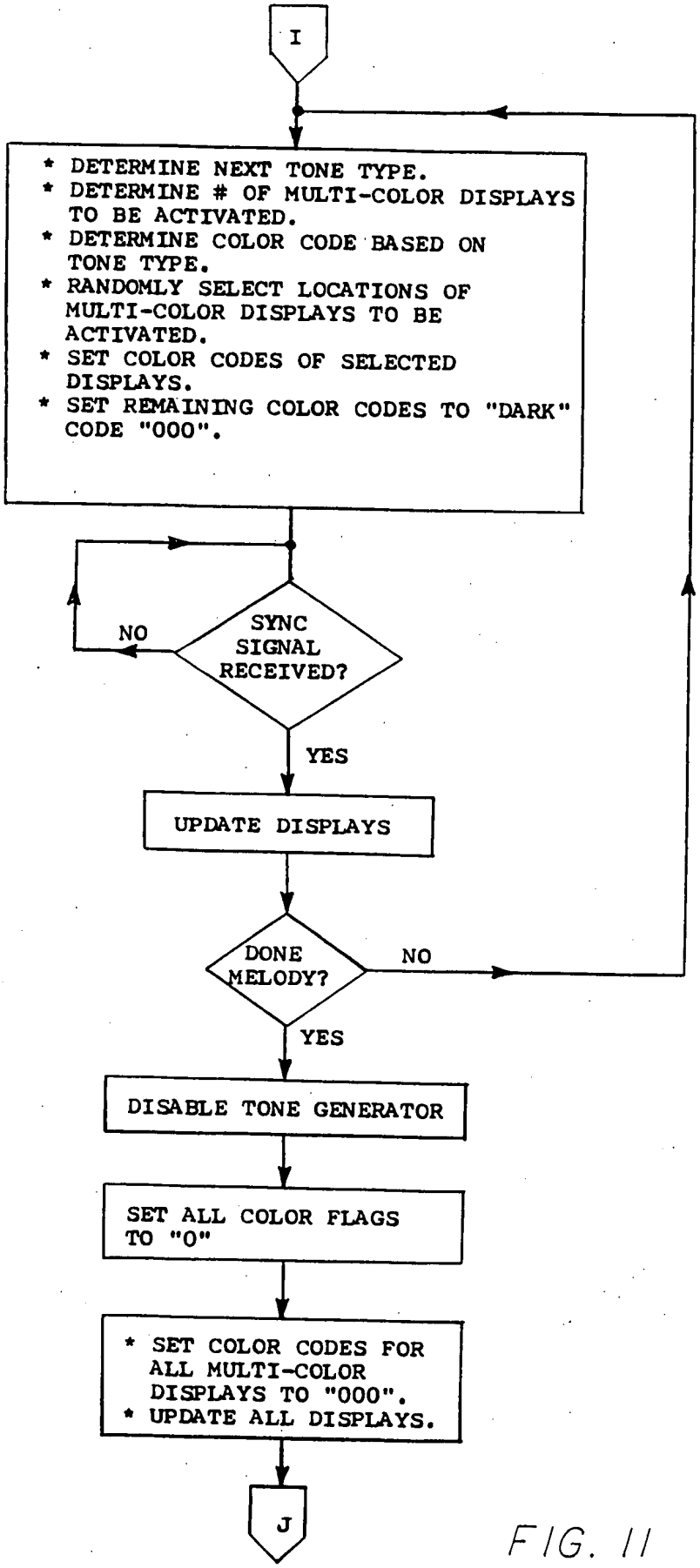

I
* DETERMINE NEXT TONE TYPE.
* DETERMINE # OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
* DETERMINE COLOR CODE BASED ON TONE TYPE.
* RANDOMLY SELECT LOCATIONS OF MULTI-COLOR DISPLAYS TO BE ACTIVATED.
* SET COLOR CODES OF SELECTED DISPLAYS.
* SET REMAINING COLOR CODES TO "DARK" CODE "000".
SYNC SIGNAL RECEIVED?
NO
YES
UPDATE DISPLAYS
DONE MELODY?
NO
YES
DISABLE TONE GENERATOR
SET ALL COLOR FLAGS TO "0"
* SET COLOR CODES FOR ALL MULTI-COLOR DISPLAYS TO "000".
* UPDATE ALL DISPLAYS.
J

FIG. 11

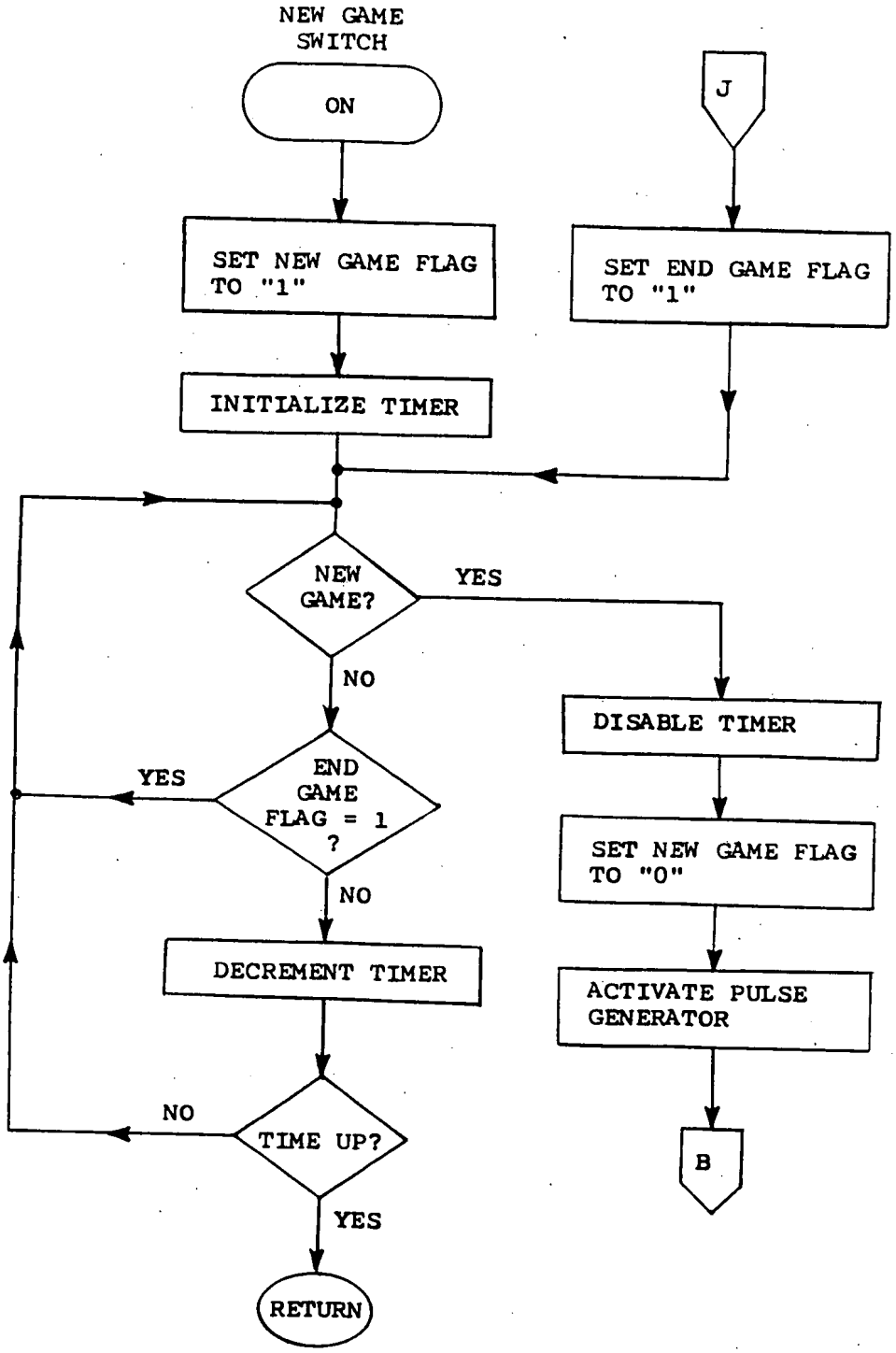

NEW GAME SWITCH
ON
SET NEW GAME FLAG TO "1"
INITIALIZE TIMER
J
SET END GAME FLAG TO "1"
NEW GAME?
YES
NO
DISABLE TIMER
END GAME FLAG = 1 ?
YES
NO
SET NEW GAME FLAG TO "0"
DECREMENT TIMER
ACTIVATE PULSE GENERATOR
TIME UP?
NO
YES
B
RETURN

FIG. 12

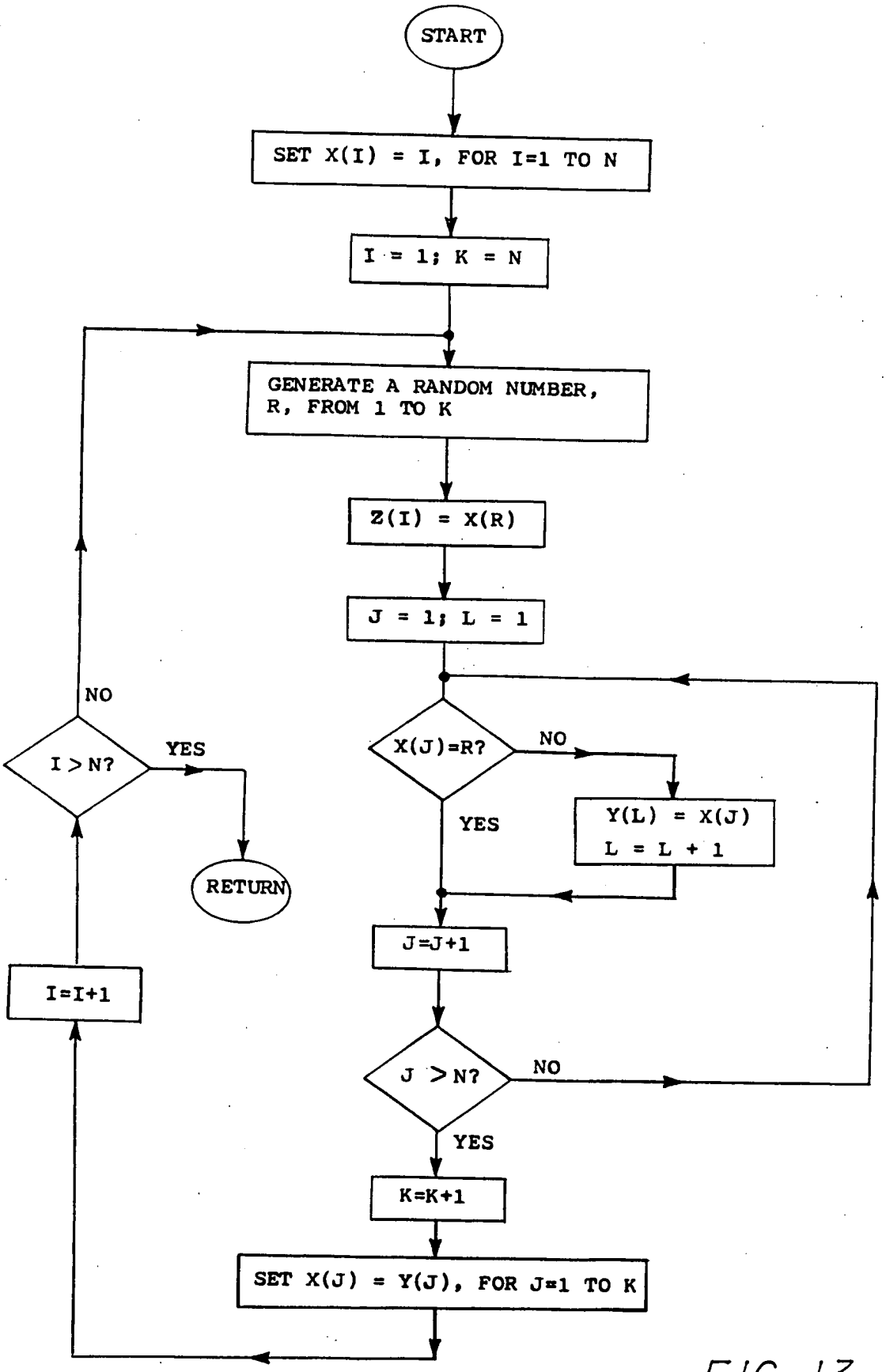

START
SET X(I) = I, FOR I=1 TO N
I = 1; K = N
GENERATE A RANDOM NUMBER, R, FROM 1 TO K
Z(I) = X(R)
J = 1; L = 1
X(J)=R?
NO
YES
Y(L) = X(J)
L = L + 1
J=J+1
J > N?
NO
YES
K=K+1
SET X(J) = Y(J), FOR J=1 TO K
I > N?
NO
YES
RETURN
I=I+1

FIG. 13

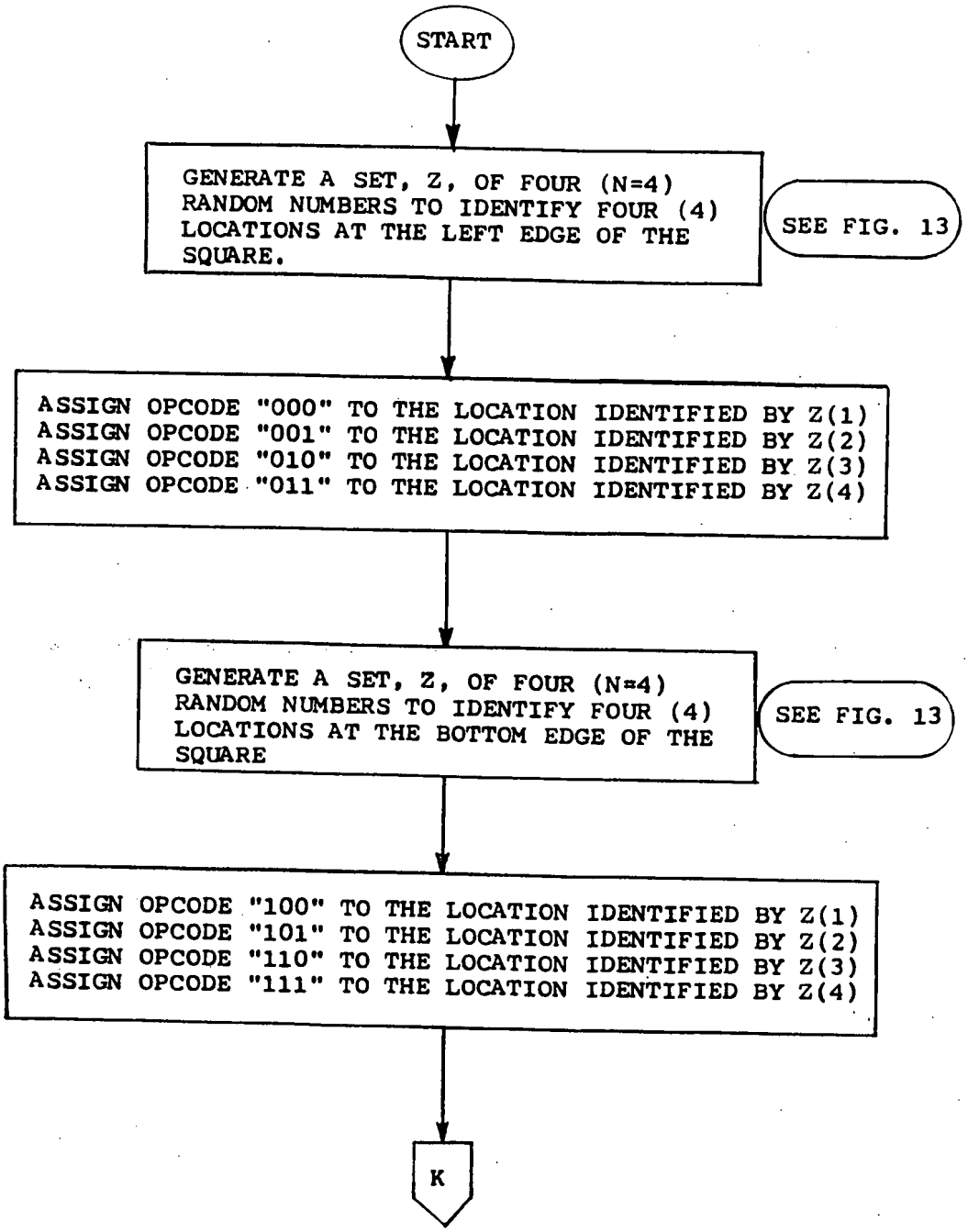

START
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE LEFT EDGE OF THE SQUARE.
SEE FIG. 13
ASSIGN OPCODE "000" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "001" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "010" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "011" TO THE LOCATION IDENTIFIED BY Z(4)
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE BOTTOM EDGE OF THE SQUARE
SEE FIG. 13
ASSIGN OPCODE "100" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "101" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "110" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "111" TO THE LOCATION IDENTIFIED BY Z(4)
K

FIG. 14

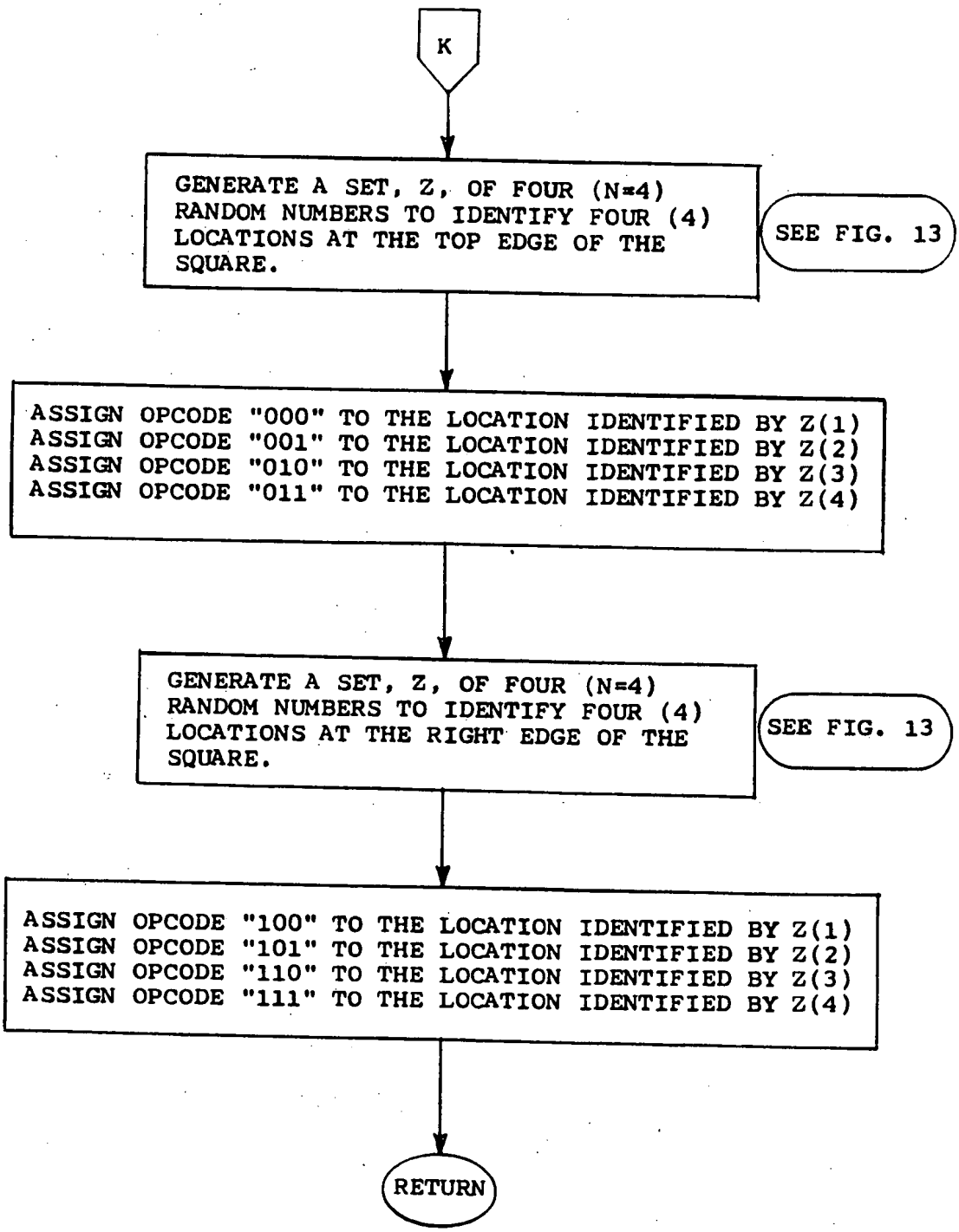

K
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE TOP EDGE OF THE SQUARE.
SEE FIG. 13
ASSIGN OPCODE "000" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "001" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "010" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "011" TO THE LOCATION IDENTIFIED BY Z(4)
GENERATE A SET, Z, OF FOUR (N=4) RANDOM NUMBERS TO IDENTIFY FOUR (4) LOCATIONS AT THE RIGHT EDGE OF THE SQUARE.
SEE FIG. 13
ASSIGN OPCODE "100" TO THE LOCATION IDENTIFIED BY Z(1)
ASSIGN OPCODE "101" TO THE LOCATION IDENTIFIED BY Z(2)
ASSIGN OPCODE "110" TO THE LOCATION IDENTIFIED BY Z(3)
ASSIGN OPCODE "111" TO THE LOCATION IDENTIFIED BY Z(4)
RETURN

FIG. 15

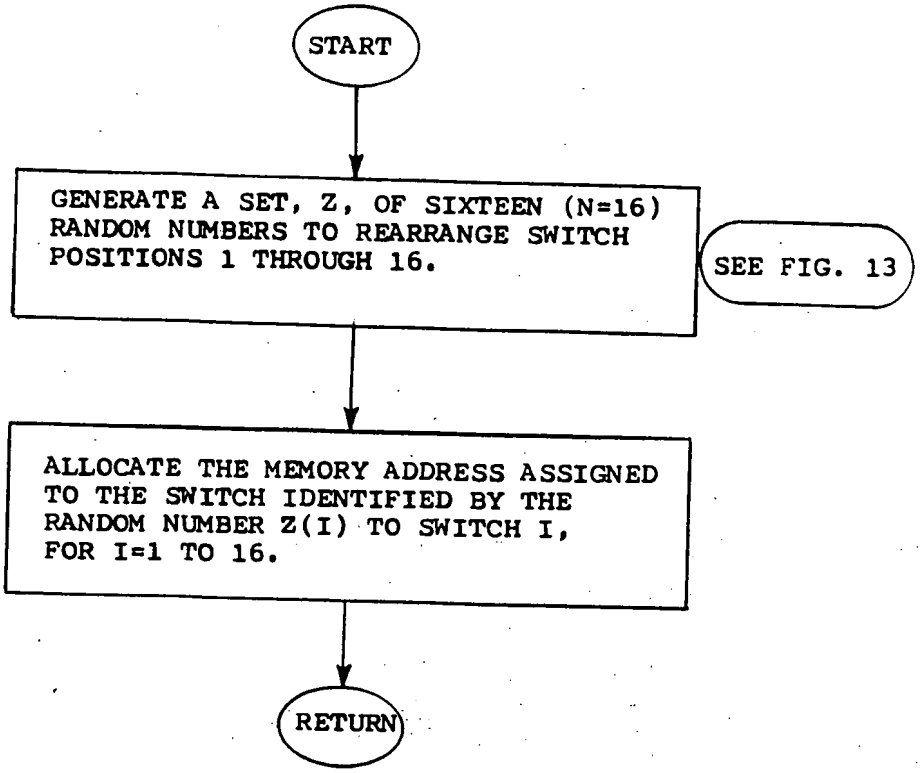

START
GENERATE A SET, Z, OF SIXTEEN (N=16) RANDOM NUMBERS TO REARRANGE SWITCH POSITIONS 1 THROUGH 16.
SEE FIG. 13
ALLOCATE THE MEMORY ADDRESS ASSIGNED TO THE SWITCH IDENTIFIED BY THE RANDOM NUMBER Z(I) TO SWITCH I, FOR I=1 TO 16.
RETURN

FIG. 16

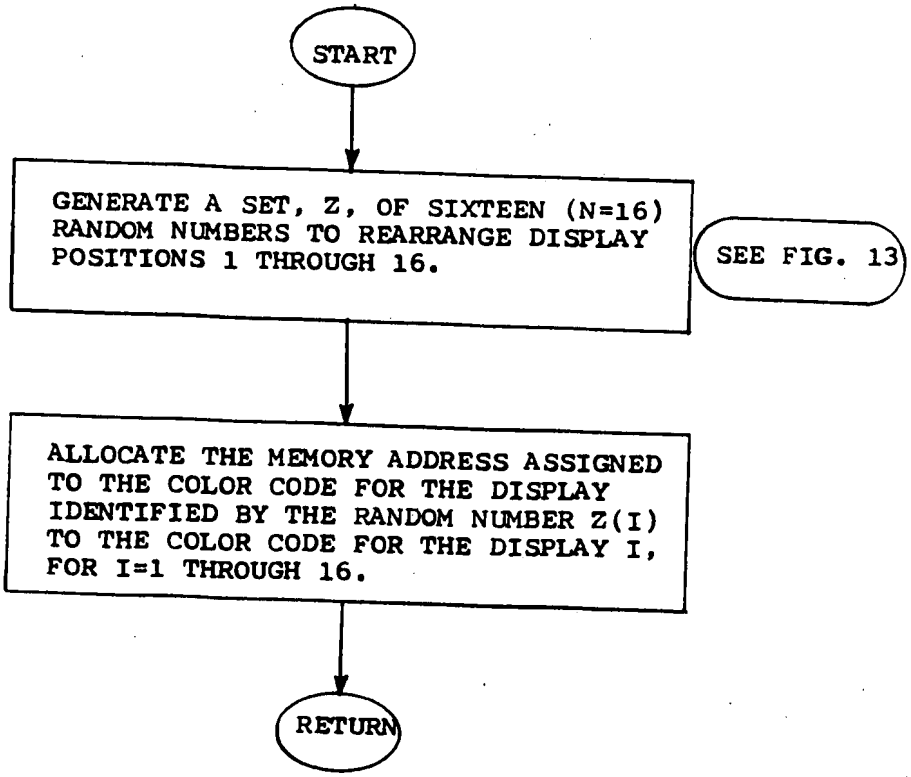

START
GENERATE A SET, Z, OF SIXTEEN (N=16) RANDOM NUMBERS TO REARRANGE DISPLAY POSITIONS 1 THROUGH 16.
SEE FIG. 13
ALLOCATE THE MEMORY ADDRESS ASSIGNED TO THE COLOR CODE FOR THE DISPLAY IDENTIFIED BY THE RANDOM NUMBER Z(I) TO THE COLOR CODE FOR THE DISPLAY I, FOR I=1 THROUGH 16.
RETURN

FIG. 17

LEGEND

N : DIMENSION OF LOGIC GAME = NUMBER OF PREDETERMINED COLORS WHICH MAY BE DISPLAYED.
= 4 (FOR THE PREFERED EMBODIMENT)

n : NUMBER OF BINARY BITS IN OPCODE AND COLOR CODE.
= 1n N + 1 = 3 (FOR THE PREFERED EMBODIMENT)

I : ROW NUMBER I, I = 1, ..., N

J : COLUMN NUMBER J, J = 1, ..., N

DIR : ROUTE DIRECTION BETWEEN TWO ADJACENT ROUTING SQUARES;
"R" DENOTES RIGHT
"U" DENOTES UP
"L" DENOTES LEFT
"D" DENOTES DOWN

T : OPCODE TRANSMITTER; T = 1, ..., 2N

R : OPCODE RECEIVER; R = 1, ..., 2N

RC(T) : RECEIVER CONNECTED TO TRANSMITTER "T"

TC(R) : TRANSMITTER CONNECTED TO RECEIVER "R"

W(I,J) : STATUS OF SWITCH LOCATED AT ROW "I" AND COLUMN "J"

TCODE(T) : OPCODE AT TRANSMITTER "T"

RCODE(R) : OPCODE AT RECEIVER "R"

C(R) : COLOR CODE AT RECEIVER "R"

x(i) : THE ith BIT OF OPCODE "X"

y(i) : THE ith BIT OF OPCODE "Y"

cb(i) : THE ith BIT OF COLOR CODE "C"

C1(I,J) : COLOR CODE AT THE RIGHT EDGE OF THE ROUTING SQUARE LOCATED AT ROW "I" AND COLUMN "J"

C2(I,J) : COLOR CODE AT THE TOP EDGE OF THE ROUTING SQUARE LOCATED AT ROW "I" AND COLUMN "J"

C(I,J) : COLOR CODE SELECTED FOR DISPLAY AT THE ROUTING SQUARE LOCATED AT ROW "I" AND COLUMN "J"

$\oplus$: EXCLUSIVE OR BOOLEAN FUNCTION

$\odot$: INCLUSIVE OR BOOLEAN FUNCTION

EXPLANATION OF PROGRAM VARIABLES OF FIGS. 19 - 22

FIG. 18

NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

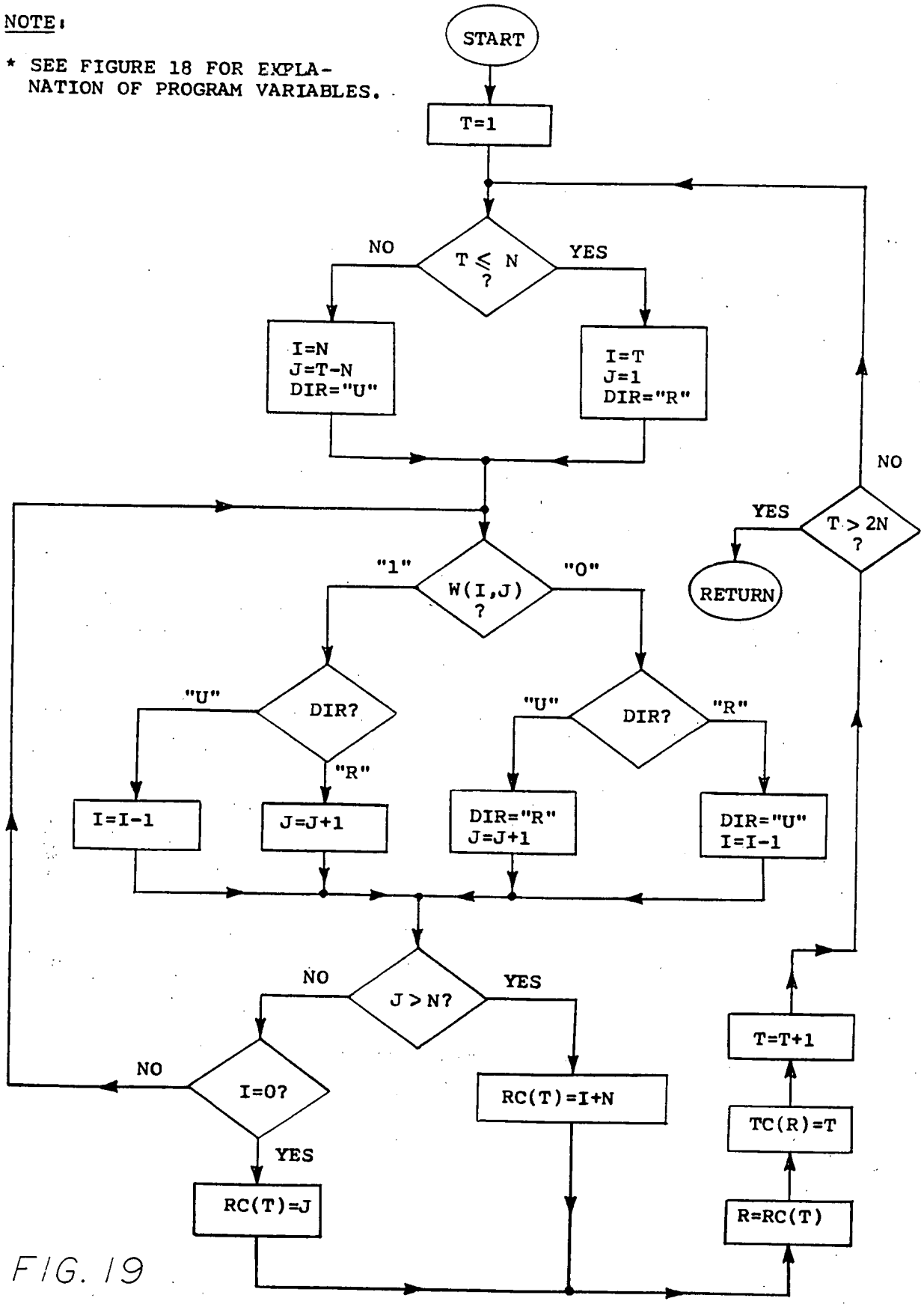
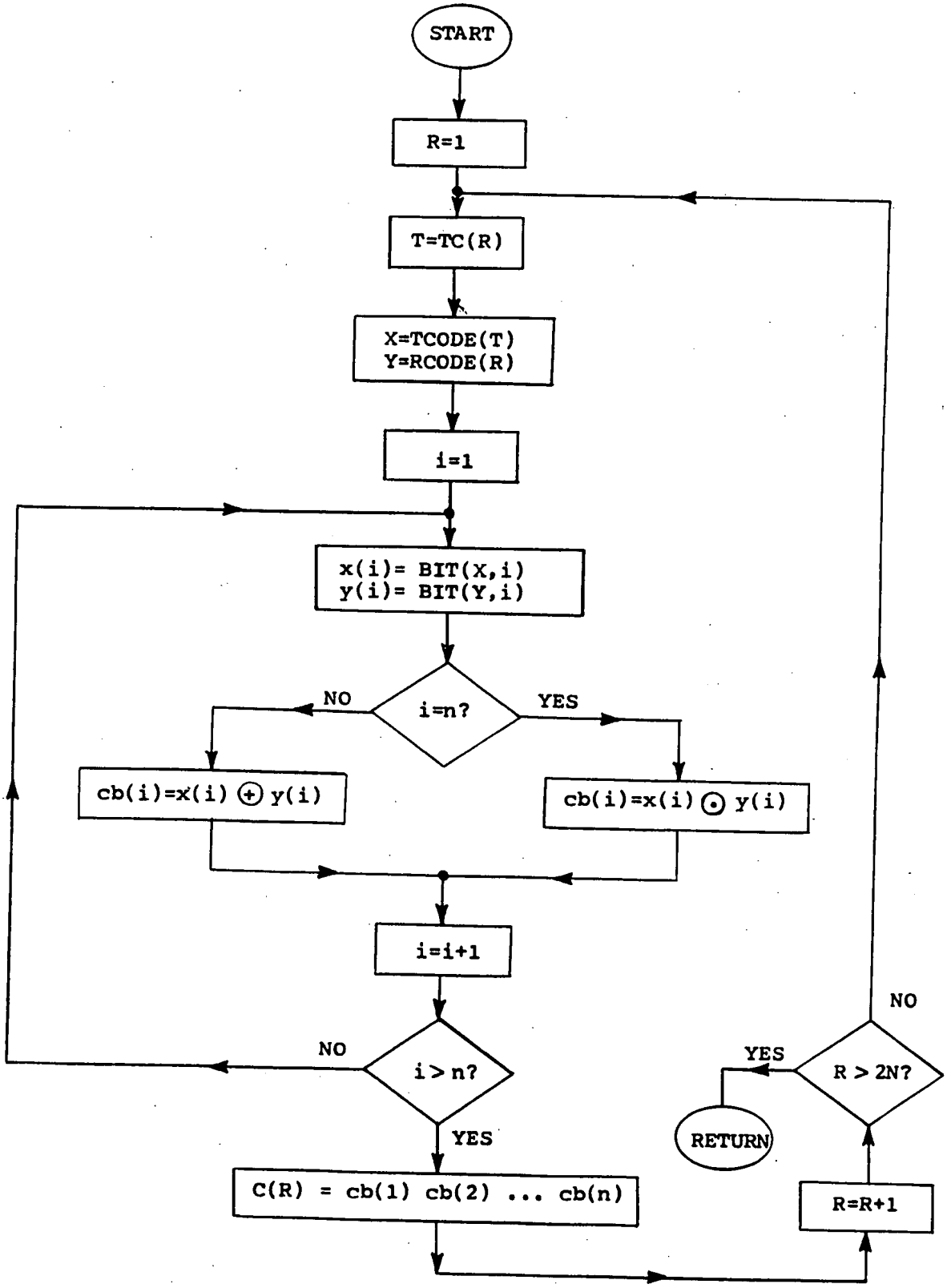


FIG. 19



NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

FIG. 20

NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

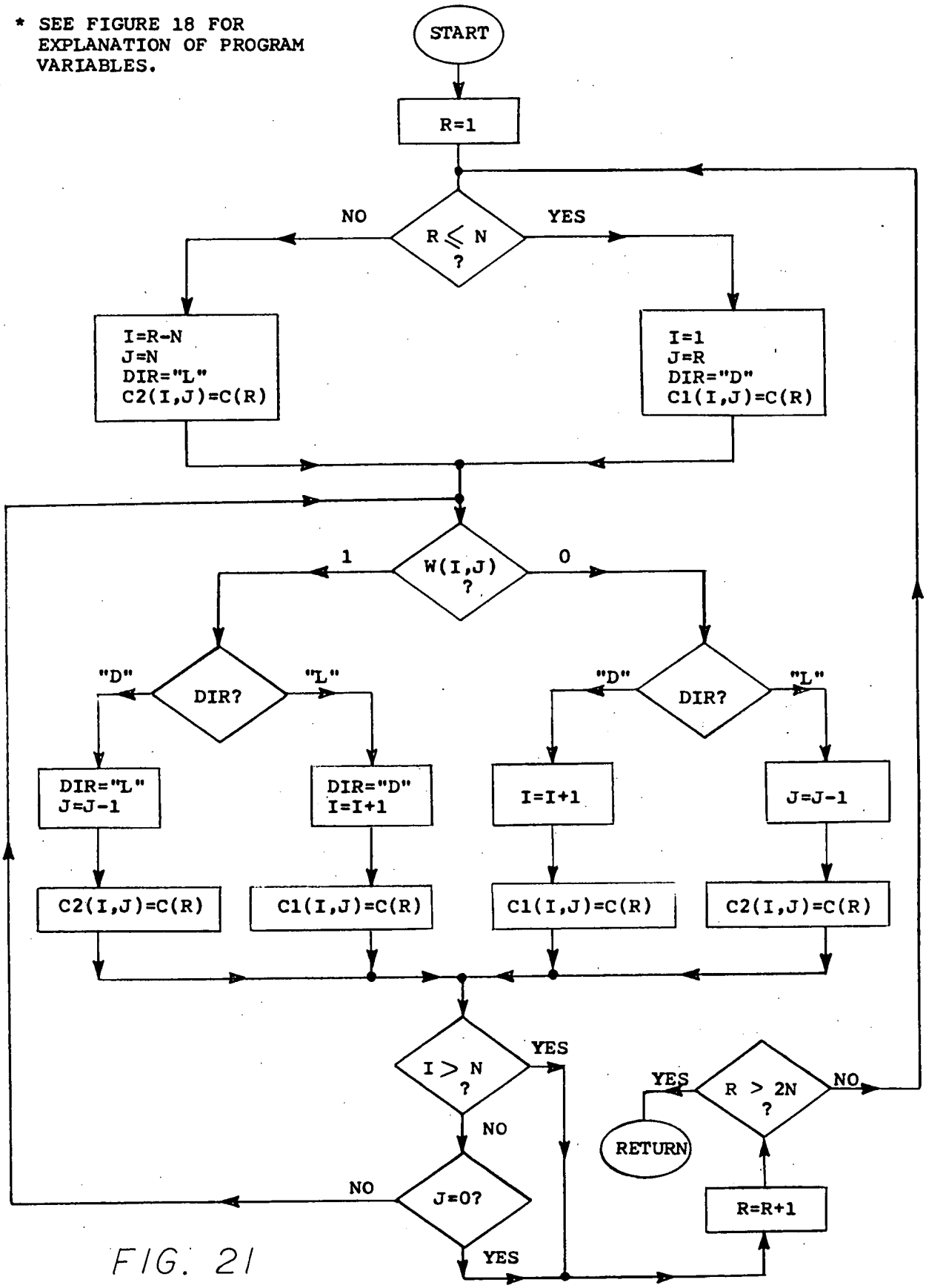
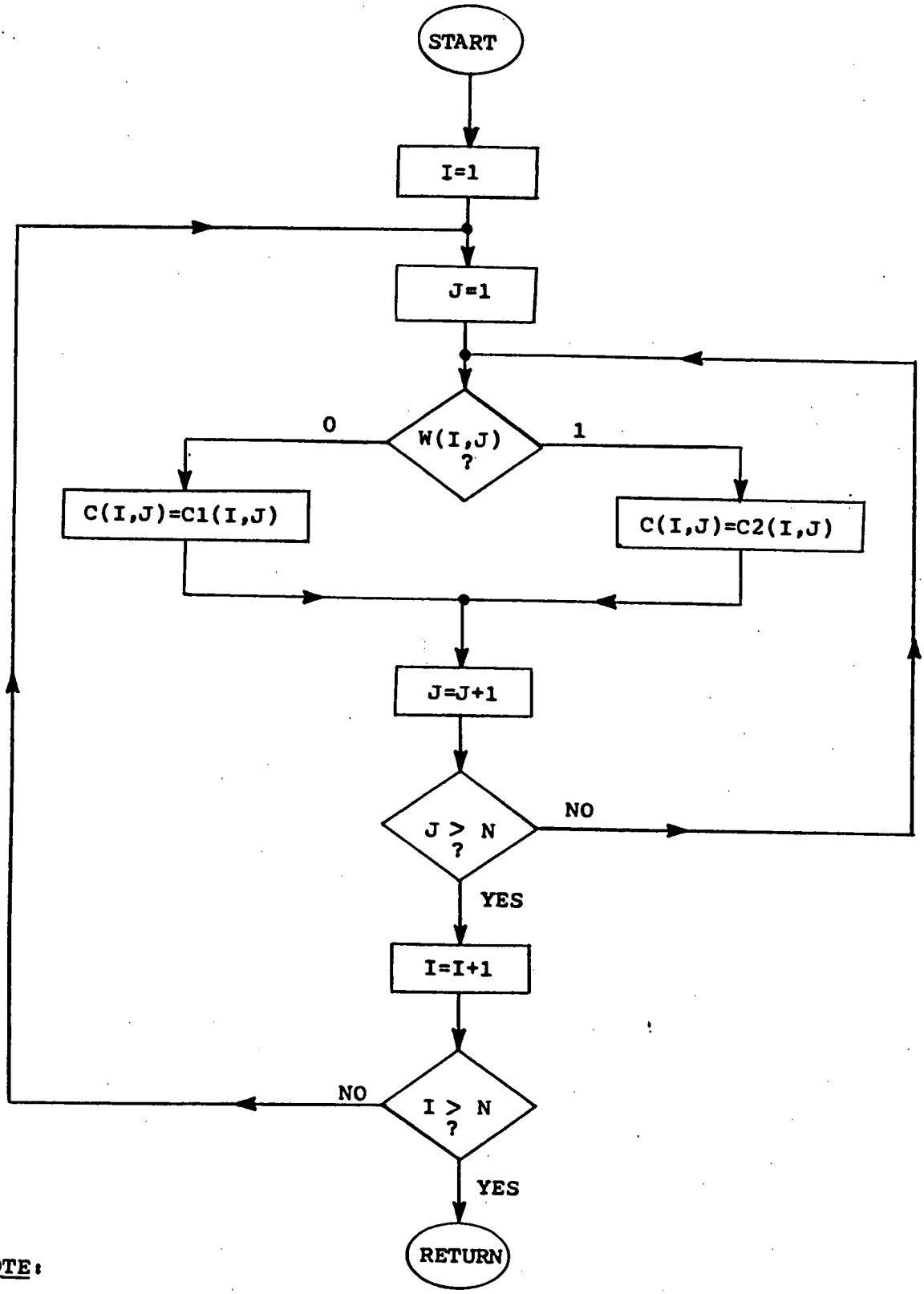


FIG. 21



NOTE:

* SEE FIGURE 18 FOR EXPLANATION OF PROGRAM VARIABLES.

FIG. 22

OPCODE	000	001	010	011	100	101	110	111
000								
001								
010								
011								
100								
101								
110								
111								

COLOR CODE	100	101	110	111
COLOR				

COLOR ASSIGNMENTS FOR N = 4

FIG. 23

OP-CODE	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000																
0001																
0010																
0011																
0100																
0101																
0110																
0111																
1000																
1001																
1010																
1011																
1100																
1101																
1110																
1111																

COLOR CODE	1000	1001	1010	1011	1100	1101	1110	1111
COLOR								

COLOR ASSIGNMENTS FOR N = 8

FIG. 24